HAM NEWS
TUBES

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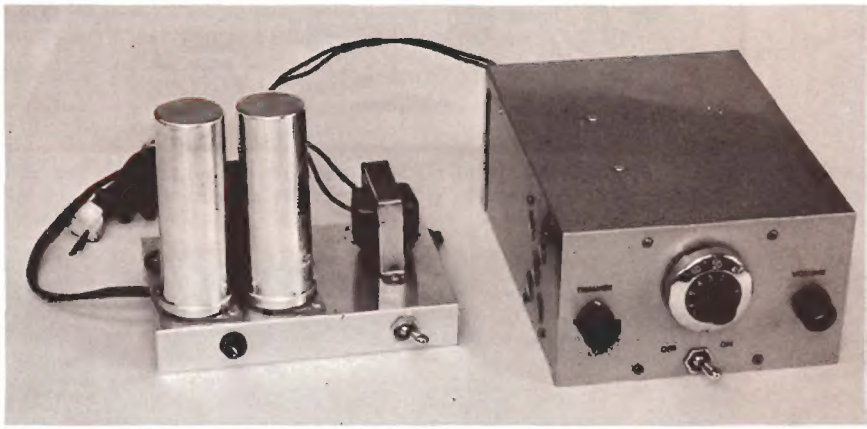
3-WAY VHF'ER

A 50—150-MC. VHF RECEIVER

By Jack Najork, K9ODE

Taking the youngsters to the airport to watch the big jets zoom in? Take along this compact little VHF receiver and let them listen to the pilots and control tower talking on the 118 megacycle aircraft frequencies. With a range of 49 to 150 megacycles, the Three-Way VHF'er will also tune in the 50 and 144-megacycle amateur bands, Civil Air Patrol frequencies, commercial FM broadcast stations and some TV sound channels.



COMPLETE VHF RECEIVER and companion power supply for AC operation. Borg Microdial was used on this model for tuning.

DESIGNED around the newer series of automobile-type tubes which require only 12 volts DC plate supply, the *Three-Way VHF'er* can be used either at home or in the car without the need for the usual mobile vibrator or transistor power supply. Total current drain of the complete receiver is approximately 1 ampere at 12 volts DC so there is no danger of depleting the car battery during extended listening periods.

For maximum flexibility the receiver is designed for three different types of operation through the use of two plug-in modules. As shown in the block diagram, Fig. 1, the unit may be operated as:

a. VHF tuner with audio output fed to an existing amplifier;
b. VHF converter with output on the broadcast band to feed into the station receiver or auto radio;
c. Complete VHF receiver with self-contained audio amplifier.

Of course, it is not necessary to construct both plug-in modules if only one type of operation is desired. However, the use of modules helps anticipate the needs of those who make the life of the construction article author hectic by requesting information on how to build one, "just like it except . . . "

THE BASIC RECEIVER circuit consists of a 12EK6 pentode operating as a tuned RF stage feeding a second 12EK6 in a superregenerative detector. While this combination cannot be expected to compare in sensitivity and selectivity to the more elaborate crystal-controlled converter and station receiver combination, it does a good job on the stronger signals and delivers a lot of performance for a modest investment.

Since the VHF spectrum is relatively uncrowded, the receiver's band-width of approximately 300 Kilocycles is not a major disadvantage but rather, permits non-critical tuning of AM stations and also good slope detection of wide-band FM broadcast stations. Narrow-band FM signals—police, fire and commercial services—cannot be received satisfactorily with this receiver because the narrow frequency swing of these signals will develop very little audio output from the detector. The inherent AVC action and impluse noise limiting characteristics of the superregenerative detector are important features if the set is to be used for mobile operation.

Continuous frequency coverage from 49 to 150 megacycles is obtained without bandswitching or plug-in coils by use of a *Mallory Inductuner* which was widely used some years ago in TV receiver front ends. A good source of *Inductuners* is the back-room and basement graveyards of defunct TV sets in TV repair shops. The Inductuner front end can be easily identified by the lack of a "click" type channel selector switch. *Crosley, Emerson* and *Dumont* are some of the manufacturers who incorporated the *Inductuner* in 10 and 12-inch TV receivers.

K9ODE OPERATES the three-way VHF receiver *(top)* in his office, and (bottom) in his automobile. Receiver in car is mounted on brackets hung from the sides of G-E Transistorized Progress Line (TPL) Two-way radio. Jack is District Sales Manager in Chicago for General Electric's Communication Products Department. His previous article in **G-E HAM NEWS** wos "Inductive Tuning For High-C RF Oscillators" (September-October, 1961, Vol. 16 No. 5).

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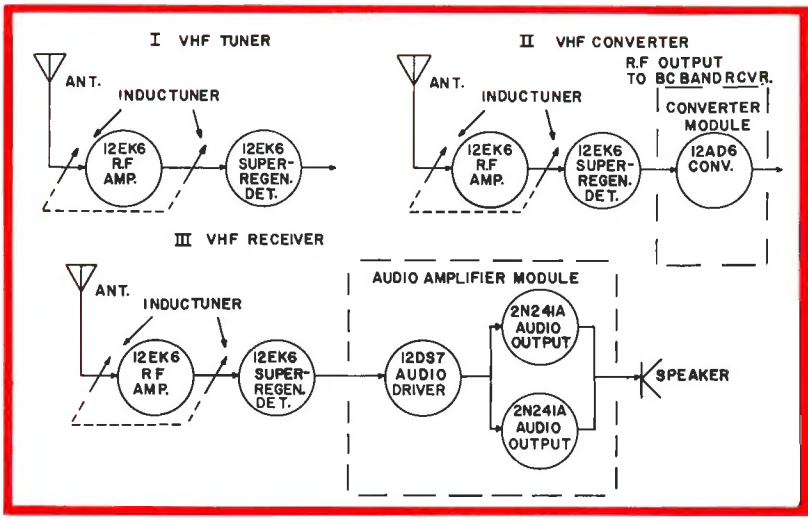


FIG. 1. BLOCK DIAGRAM of the three-way VHF receiver, showing the possible choices of (1) VHF tuner; (2) VHF converter; (3) a complete receiver with built-in audio amplifier and speoker.

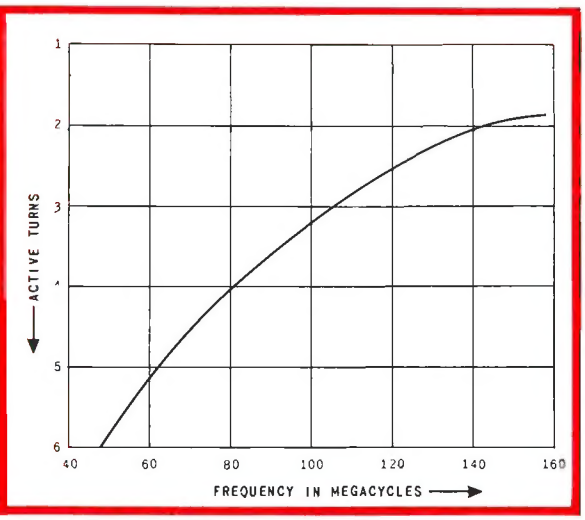
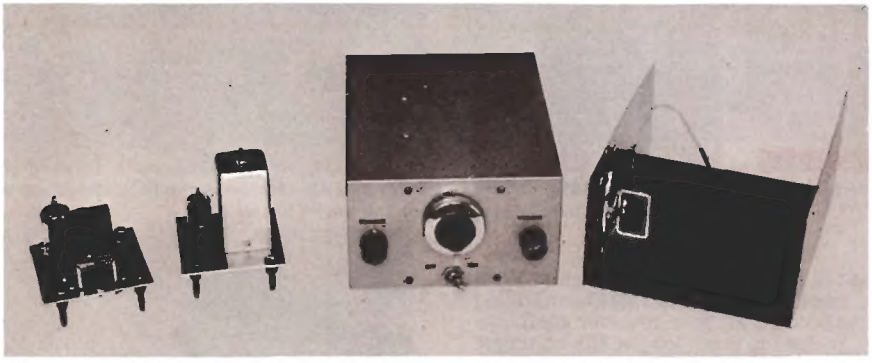


FIG. 2. TUNING CURVE for the VHF receiver constructed by K9ODE showing the approximate active number of Inductuner turns in the circuit to cover the range from 50 to 150 megacycles.



VHF RECEIVER is shown with other half of cabinet holding speaker, and the two plug-in modules; (left) the audio amplifier module; and the converter module.

The usual *Inductuner* TV front end covered a range of 54 to 220 megacycles; however, in this receiver the upper tuning limit is dictated by the superregenerative detector circuit which stops "supering" around 155 megacycles. Frequency coverage Vs. tuning dial rotation is shown in Fig. 2.

CIRCUIT DETAILS —

The 12EK6 RF stage in the schematic diagram, Fig. 3, is a conventional pentode amplifier. But, unlike standard tube circuits, screen dropping and cathode bias resistors are not required. Plate and screen voltages are fed directly from a 12 to 15-volt DC source, and a high value grid resistor develops contact potential grid bias. With a plate supply of only 12 volts or so, a cathode bias resistor would reduce the effective plate voltage to less than ten volts, so a more efficient way of developing grid bias must be used.

One section of the *Inductuner* is used to tune the grid circuit of the RF amplifier. A front panel tuning capacitor in series with the bottom of the *Inductuner* permits trimming the RF stage to compensate for reactance introduced by various types of antennas and transmission lines. The antenna is coupled directly to the grid of the RF stage through a small coupling capacitor. Although this is not the ideal method of matching a low impedance transmission line, the continuously variable Inductuner does not permit the usual tapped input coil connection.

Plate voltage for the RF stage is fed through RFC_1 and the output of this stage is capacitively coupled to a triode-connected 12EK6 superregenerative detector. The usual regeneration control is not needed because the detector superregenerates smoothly without critical setting of plate voltage. Output of the detector is fed through a miniature audio interstage transformer to the front panel volume control and then to the "audio" terminal on the rear of the cabinet.

Resistor R_3 connected across the volume control prevents "fringe howl", an audio oscillation sometimes encountered with regenerative transformer-coupled detectors. If a transformer different than that specified on the parts list is used this resistor may not be required. With some types of transformers (including the one used in this receiver) the detector does not actually howl but the audio output sounds extremely hollow. For a given transformer, R_3 should be as high in value as possible consistent with elimination of this condition.

The two tube portion of the receiver can be used by connecting the audio output to the phono input jack of the station receiver or to an existing audio amplifier or hi-fi amplifier with high impedance input.

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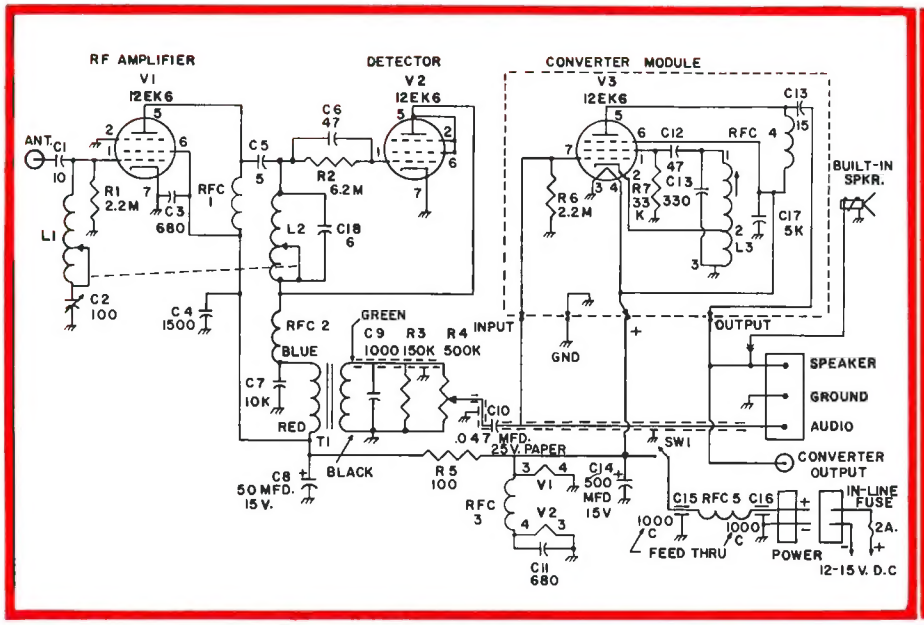


FIG. 3. SCHEMATIC DIAGRAM of the basic VHF receiver. Note simple RF circuitry made possible by low-voltage auto rodio tubes. All fixed capocitors are mica or ceramic with volues in picoforads unless otherwise indicated. Resistance are in ohms, ½-watt rating unless marked.

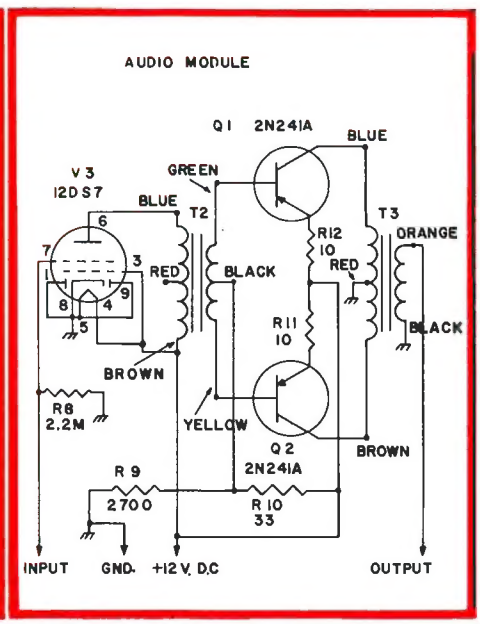


FIG. 4. AUDIO AMPLIFIER schematic diagram which can be constructed as a plug-in module, or built into the complete receiver. Transistor output stage provides about 1-watt output.

To use the receiver as a converter or as a complete receiver with self-contained audio, the appropriate module is plugged in. Four banana type jacks and plugs on the receiver chassis and modules automatically make the required input, output and power connections when a module is plugged in and it is then only necessary to make connections to terminals on the rear of the cabinet. When the converter module is used a length of coaxial cable (RG-174/U or RG-59/U) terminating in a phono-connector type jack is plugged into the "converter" jack and the other end of this line is then connected to the antenna input terminal of the broadcast receiver.

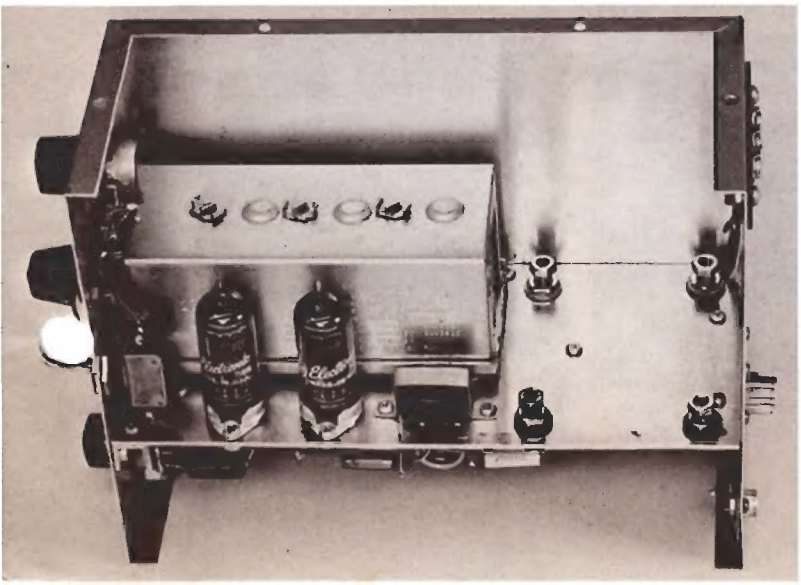
The converter module consists of a 12AD6 heptode which operates as an electron-coupled, modulated oscillator with output in the broadcast band. Audio output from the supperregenerative detector is fed into the signal grid of the 12AD6 to modulate the oscillator circuit made up of the number one grid,

TABLE I—PARTS LIST—3-WAY VHF'ER

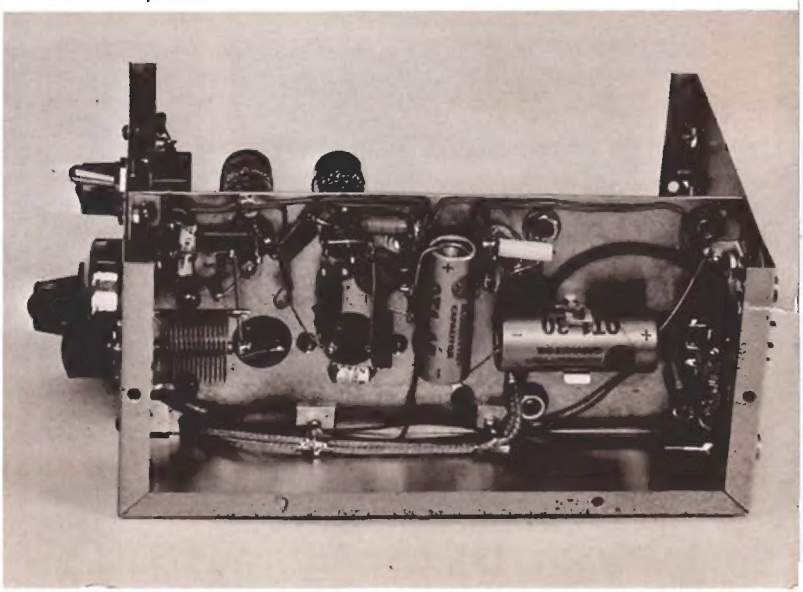
C_8....50-mfd.,50-voltelectrolytic (G-EQT1-15).
C_{14}, C_{20}....500-mfd., 15-volt tubular electrolytic (G-E QT1-30).
C_{18}, C_{19}....1500-mfd., 50-volt con type electrolytic (G-E XC1-27).
CR_1 to CR_4....100-volt, 600-ma. rectifiers (G-E 1N1692).
L_1, L_2....2.0-uh per section 2- or 3-section 6-turn spiral Inductuner[2].
L_3....adjustable inductance iron-core broadcast receiver oscillator coil (J. W. Miller No. 73-Osc. or equivalent).
L_4....Secondary of 6.3-volt, 1-amp. filament transformer; (Stancor P-6134).
Q_1, Q_2....G-E 2N241-A or GE-2 PNP AF autput transistors.
RFC_1, RFC_2....Approx. 10 uh., 60 turns, No. 28 enameled wire closewound on 2.2-megohm, 1 watt resistor.
RFC_3....Approx. 2 uh., 30 turns, No. 24 enomeled wire closewound on a $\frac{1}{4}$-inch diometer form (Ohmite Z-144).
RFC_4....2.5-mh. four-pi type RF choke (National R-100, 215 mh., or equivalent).
S_1, S_2....SPST toggle switch.
T_1....miniature interstage transformer, 10,000-ohm primary, 90,000-ohm secondary (UTC type S-2, or equivalent).
T_2....interstage transformer, 400-ohm primary, 2,000-ohm secondary, center tapped (Triad type TY-34X, or equivalent).
T_3....Output transformer, 200-ohm primary centertapped, to 4—8-ohm voice coil (Triad TY-31X, or equivalent).
T_4....12.6-volt, 2-amp. filament transformer, 115-volt primary (Thordarson T-26F27).
V_1, V_2....G-E 12EK6 RF pentode tube.
V_3....G-E 12AD6 pentagrid converter tube.
V_4....G-E 12DS7 space-charge tetrode tube.
Speaker....2½-inch midget oval PM (Newark Electric type 46X029).
Diol....Borg type 1321 10-turn Microdial.
Cabinet....3½ x 6 x 8-9 8-inch Minibox, grey hammertone finish (Bud CU-2109A).

[2]A 3-section spiral type Mallory Inductuner was advertised for $2.95 on page 113 of the March, 1962 issue of **CQ**, by **Barry Electronics Corp.**, 512 Broadway, New York 22, N.Y.

TOP VIEW of the receiver showing the Inductuner behind the two 12EK6 tubes, and T_1 to their right. Modules plug into banono jacks in open area at rear of receiver.



BOTTOM VIEW of the receiver, showing simple wiring and the insulating washers an three of the four banana jacks. Non-insulated jack is in the lower left position.



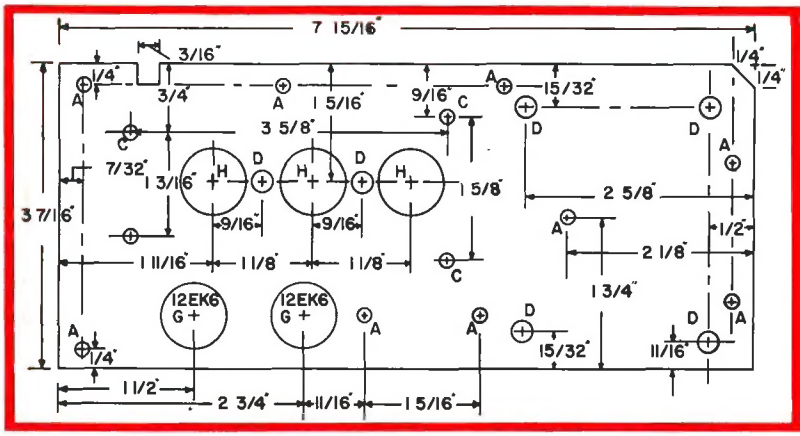


FIG. 5. CHASSIS LAYOUT DIAGRAM for the VHF receiver. Layout for a 3-section Inductuner is shown. Hole sizes are given in TABLE II—HOLE SIZE CHART. Chassis material is $\frac{1}{16}$-inch thick aluminum.

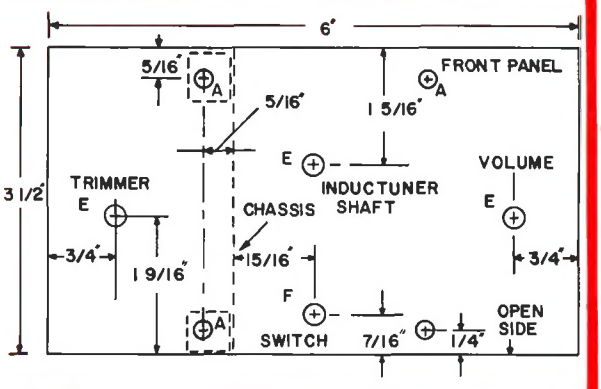


FIG. 6. FRONT PANEL LAYOUT for the VHF receiver. The Inductuner shaft should be centered in the panel hole to avoid binding. Hole sizes are given in TABLE II—HOLE SIZE CHART.

cathode and screen. RF output is taken off the plate and fed via a small coupling capacitor to the "converter" jack. The modulated signal is then tuned in on the broadcast receiver in conventional fashion. Adjustment of the tuning slug in the oscillator coil permits setting the output of the converter to a clear portion of the broadcast band. Like the 12EK6, the 12AD6 Heptode requires only 12 volts DC for plate and screen potential.

The audio module shown in Fig. 4 is made up of a transformer-coupled 12DS7 space-charge tetrode transformer-coupled to a pair of G-E 2N241A transistors in class "B". The 12DS7 is unlike a conventional tetrode in that the number one grid (grid nearest the cathode) is not the signal input grid. In the 12DS7 this is a space-charge grid connected directly to the 12 volt DC plate supply. This grid accelerates electron flow and permits the tube to operate much more efficiently from the low potential plate supply.

Signal voltage is fed into the number two grid and audio output is taken from the plate in the usual manner. Resistance coupling such as is usually employed in conventional audio stages cannot be used with any degree of success with the 12-volt series tubes because the voltage drop across the plate load resistors would lower the effective plate voltage below useable limits.

The 2N241A output transistors develop approximately ¾ watt output to drive either the internal or an external speaker. A small 2½-inch oval speaker is included on the cabinet and its output is adequate for home station use. For mobile operation a larger, more efficient external speaker should be used to overcome the higher noise level usually encountered.

The 8-ohm speaker output terminal is paralleled with the converter output jack to eliminate the need for a separate plug and socket on the module and chassis. When the converter module is used, the external and internal loudspeaker connections should be removed, otherwise the loudspeaker voice coil will shunt the converter output and decrease the signal level fed to the broadcast receiver. A slip-pin connector is used to disconnect the built-in loudspeaker for converter operation.

A low-pass filter consisting of feed-thru capacitors C_{15}, C_{16} and RFC_5 is used in the 12-volt DC input lead to prevent ignition noise from feeding into the receiver. If mobile operation is not contemplated this filter can be eliminated and the power connection run directly to the on-off switch, S_1. The receiver power input cable should contain an in-line two ampere fuse as protection against melted ignition system wiring in case the receiver develops an internal short.

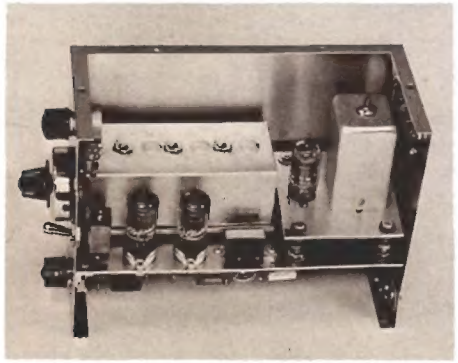
CONSTRUCTION —

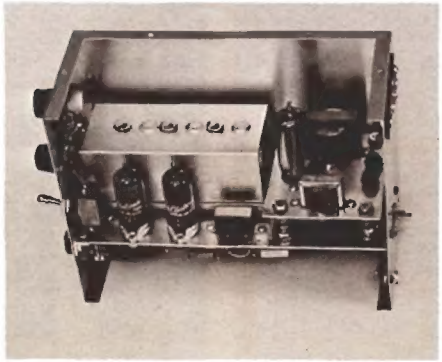
The receiver is built into a standard gray hammertone finish aluminum mini-box measuring 3½ x 6 x 8 inches (*Bud* CU-2109 or similar). One end of the cabinet is used as the front panel so that only 3½ x 6 inches are required for under-the-dash mobile mounting. A strip of 14-gauge aluminum 3$\frac{7}{16}$ x 7⅞ inches serves as the main chassis. If a bending brake is available this chassis can be fabricated with right angle bends which are then bolted to the "U" shaped cabinet enclosure. In lieu of this, the chassis can be cut to size and small right-angle brackets can be used as shown in the photographs to secure the plate to the cabinet with No. 4 machine screws and nuts. Two angle brackets are used on each of the three sides which come in contact with the cabinet.

The main chassis drawing, Fig. 5, shows the location of the necessary holes. It is advisable to check the dimensions of the Inductuner mounting holes because these may vary — depending on the vintage of the Inductuner used — and they may not agree with those shown on the drilling diagram. The *Inductuner* is shimmed up from the chassis 3/32 of an inch to permit the plastic terminal strips to clear, since these project from the bottom of the unit. If the specified *Borg* Model 1321 *Microdial* is used the Inductuner shaft must extend from the front panel by $\frac{13}{64}$ to $\frac{13}{16}$ of an inch, so do not cut this shaft until the final position of the inductuner is determined.

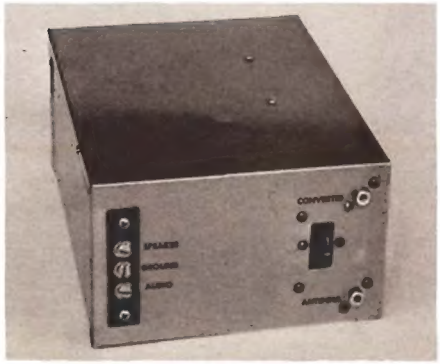
The chassis plate is positioned inside the cabinet so that the Inductuner shaft is exactly centered on the panel end of the cabinet. These dimensions are shown on the front panel drawing, Fig. 6.

No. 10 machine screws are used to secure the Inductuner to the chassis and these screws thread into the existing threaded holes on the unit. Slip soldering lugs under the two screws nearest the cabinet side as these points will be





SIDE VIEWS of the VHF receiver showing (left) the converter module plugged in, and (right) the audio amplifier module in place. All connections are made through the four banana plugs, as shown in the schematic diagram, Fig. 3.



REAR VIEW of the receiver, showing the positions of the antenna and output jacks, power plug and audio terminal strip.

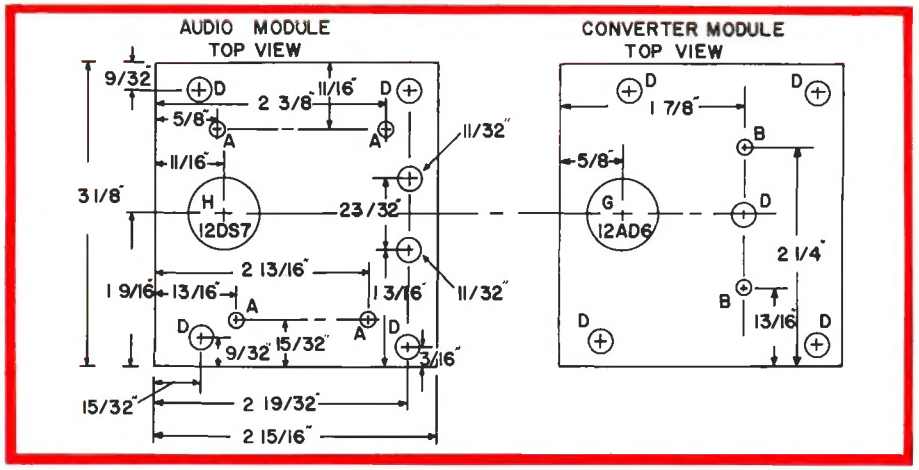


FIG. 7. LAYOUT DIAGRAMS for the converter and audio module subchassis. Material is also 14-gauge aluminum. Locate the holes for the banana plugs from the matching jack holes in the main chassis.

TABLE II—HOLE SIZE CHART

"A" drill—No. 31 (.120) clears 4-40 screw.
"B" drill—No. 26 (.147) clears 6-32 screw.
"C" drill—No. 9 (.196) clears 10-32 screw.
"D" drill—¼-inch in diameter.
"E" drill—⅜-inch in diameter.
"F" drill—½-inch in diameter.
"G" socket punch—⅝-inch in diameter for 7-pin miniature tube socket.
"H" socket punch—¾-inch in diameter for 9-pin miniature tube socket.

used as ground connections. The lug near the front panel is used as a ground point for trimmer capacitor C_2 and the rear lug is used as a ground point for electrolytic capacitors C_8 and C_{14}.

A two terminal strip bolted an inch forward of the 12EK6 RF socket serves as the tie point for the antenna coax cable and for the termination of RFC_1 and plate-by-pass C_4. No. 18 tinned bus wire is used for RF connection 5. One heater pin, the cathode and the suppressor of the RF tube socket are strapped together and grounded to a lug under the front terminal strip mounting screw.

The No. 4 machine screws and nuts which secure transformer T_1 are used to secure terminal strips to the rear of the detector socket. A three terminal strip is used nearest this socket to serve as tie points for RFC_3, the 100 ohm resistor R_3 and one end of electrolytic capacitor C_3. The detector RFC_2 is connected between this terminal strip and the *Inductuner* terminal.

The two terminal strip under the rear screw of the transformer bolt serves as a tie point for by-pass capacitor C_9, audio coupling capacitor C_{10}, and the transformer lead connections to the shielded wire running to the volume control through a small cut-out in the chassis. The two No. 4 screws and nuts which balance up the two screws used to secure the chassis to the front panel are also used as grounding tie points for the shielded cable routed across the inside of the front panel to the volume control.

Insulated shoulder washers are used to mount the module banana jacks on the chassis. The location of these should be staggered as shown to prevent the possibility of a module being plugged in incorrectly. A small cut-out on the cabinet and corner of the chassis permits routing of leads to the speaker and audio terminal strip.

Feed-through capacitors C_{15} and C_{16} are soldered to small, right-angle brackets bolted to the screws which secure the power input plug. RFC5 is then soldered between these capacitors.

RG-174/U coaxial cable, ⅛ inch in diameter, is used to connect the antenna input terminal to the front terminal strip. If this type cable is not readily available the slightly larger RG-59/U can be used.

The 2½-inch loudspeaker specified on the parts list just fits nicely between the bottom of the chassis and the cabinet cover plate and this clearance should be checked if a different type of speaker is used. This location of the speaker is to be preferred because sound is directed out on the driver's side of the cabinet when the receiver is mounted on the usual center of the automobile dash above the floorboard hump.

The *Borg Microdial* is designed for collar mounting to *Micropot* potentiometers and the instruction sheet accompanying the dial does not show any other method of mounting. The following procedure should be followed. Disassemble the dial by loosening the No. 3 set screw on the outer edge of the dial. (Do not try to loosen the screw on the end of the knob). Slide off the back plate. Remove the dial locking plate.

The back plate has a series of small holes which will accept No. 4 machine screws. Carefully center the backplate on the front panel *Inductuner* shaft making sure the No. 3 set-screw hole is toward the bottom of the panel so the dial will be correctly oriented. Using the backplate as a template, mark two mounting holes on the panel and drill with a No. 28 drill. Bolt the back plate to the panel using flat-headed No. 4 machine screws and nuts. Getting the nuts on the bolts will take a bit of doing because the bolt ends will be partially behind the *Inductuner*. Remove the *Inductuner* cover to gain more access if required.

With the back plate bolted to the panel, set the *Inductuner* shaft to maximum inductance. (Wipers on outside edge of concentric coils). Set the dial mechanism to 0-0 and slip it on the back-plate. Tighten the No. 3 set screw and the Allen head set screw in the knob. If the dial binds at some spots it may be necessary to remove the front portion and reposition the back plate slightly until good alignment between the *Inductuner* shaft and dial is obtained.

Construction of the modules is straight-forward and all necessary details can be seen in the photographs, and layout drawings, Fig. 7.

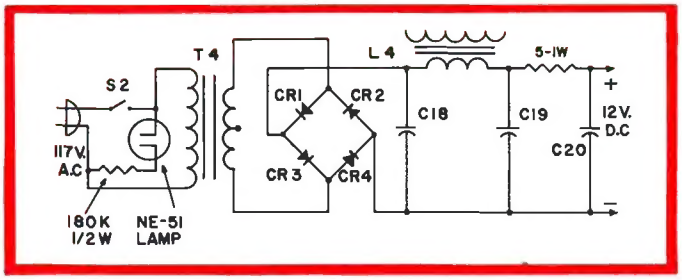
A-C POWER SUPPLY —

The diagram for an AC power supply for 117 V AC operation of the receiver is shown in Fig. 8. Approximately ¾ of an ampere at 12 volts DC is required when the unit is operated as a complete receiver. A well-filtered supply is necessary because of the high audio gain of the receiver and this is assured by the three section filter.

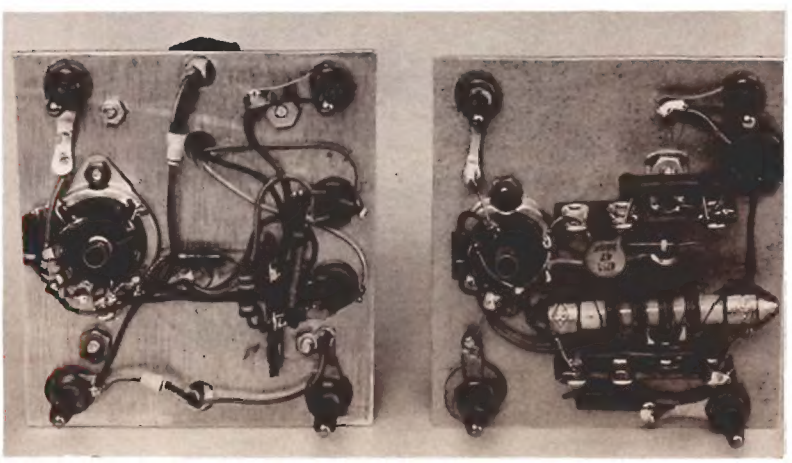
Twelve volts AC from the secondary of the filament transformer is rectified by the full-wave bridge rectifier using four 1N1692 silicon rectifiers. The filter choke, L_1 consists of the secondary winding of a small 6.3 volt filament

(Continued on page 7)

FIG. 8. SCHEMATIC DIAGRAM for the AC power supply for the VHF receiver. Components are described in TABLE I—PARTS LIST.



BOTTOM VIEW of the plug-in modules, with (left) the converter madule using a 12AD6 pentagrid converter tube, and (right) the audio amplifier module. The 2N241A output stage transistors plug into 3-pin miniature transistor sockets.



MOBILE RADIO CONTROL UNIT

By John J. Borzner, 20Q2918

While the operation of radio equipment is not exceedingly difficult, the amateur operating mobile also has to contend with the driving of the automobile. This alone is a full time job. In order to simplify radio operation and provide a safety factor necessary in traffic, the finger tip remote control head described here is recommended for installations where the radio equipment cannot be located close to the driver's seat.

In the installation shown in the picture, a Heathkit transceiver model GW-10 for the Citizen's Band is mounted in a convenient spot in the car. This does not always allow easy operation of controls. Attaching a small remote control headat a handy location on the dash will provide easy operation of the set. The circuit can be easily adapted to work with many other transceivers and separate transmitter-receiver units on the market.

This unit consists of a key-lock on/off switch, power pilot light, volume control, and hanger for the microphone. Since this transceiver is crystal controlled on both transmit and receive, no tuning facility is required.

The wiring of the control head is very simple and uncluttered. By using subminiature parts the box size can be reduced even more. 12 volts DC is brought directly into the switch, as shown in the schematic diagram, Fig. 1. From the switch the voltage goes to the pilot lamp (one side of which is grounded), then to the existing transceiver fuse.

Volume is controlled by means of a pad across the receiver speaker. The receiver volume/on-off switch is left to the ON FULL position. The schematic is self-explanatory on the pad operation. Only one wire into, and two wires out of the control head, are required. The control head is grounded when mounted under the dash.

The pilot lamp can be eliminated if the transceiver already has one; however, a bright light nearer to eyelevel avoids the possibility of a dead battery due to the set being left on accidentally while the car is parked. The microphone shown has a push-to-talk switch built in. If the mike to be used has the talk/receive switch on the cabinet, a similar switch should be added to the control head.

Only a simple cabinet is required; and it consists of a small utility box cut to the dimensions shown or to the sizes required by the parts that you elect to use. Mount all parts rigidly and anchor all wiring securely as for all mobile applications. Crimp wires to their connections and solder extra well. Road vibrations are hard on electronic equipment.

Installation of the control head in the car depends entirely on the make. It would be impossible to go into mountig details with such a variety of dashboards available. However, this is one of the basic objectives of the unit; it should be easy to mount in almost every car on the road, large or small. The most difficult task is in locating the transceiver itself. Again this will depend on the car, but it is probable that a convenient spot out of the way will be found.

After locating the transceiver and mounting the control unit it is ready to be tested on the air. If the radio is mounted too far from the control unit the microphone cable may need to be lengthened so that too long a stretch doesn't result. To operate the set, simply turn on the key lock switch. You may also need to adjust the squelch on the receiver section but once set, it should not need further adjustment. With pre-set receiver and transmitter (usually crystal controlled, a must for Citizen's band) all that remains is to talk into the microphone.

The unit shown has gone many miles in the author's car, covering most states on the eartern seaboard on both business and pleasure and has been well worth the construction time in added convenience.

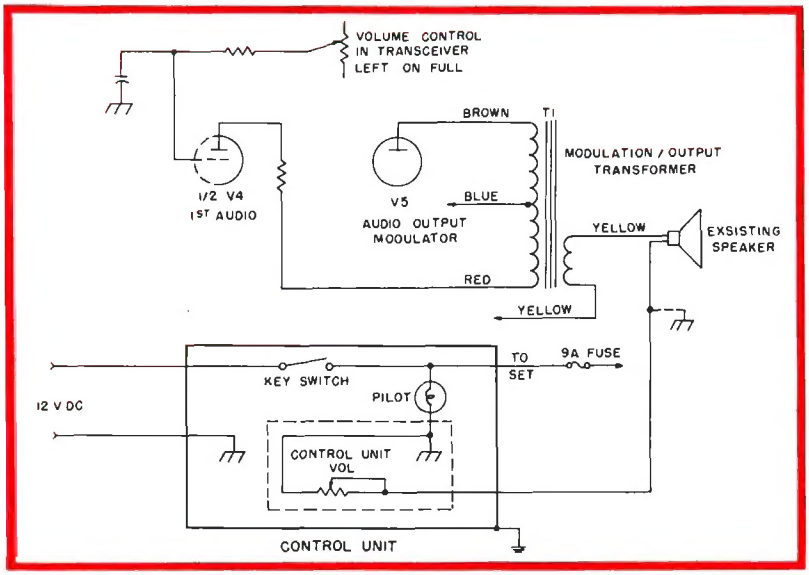
TABLE I—PARTS LIST

1 Bud Minibox to suit (about 4 x 2¼ x 2¼).
1 ½-inch green jewell panel light assembly (DIALCO 810M or 810B).
1 6 or 12 volt GE bulb to fit pilot lamp.
1 "L" pad 4 to 10 ohms (outdoor theater type recommended to withstand mobile use).
1 Lock type auto ignition switch, available at auto stores (or Arrow-Hart and Hegeman type 81715L).
1 Knob for pad (National type HR).
Optional decal set Tekni-Calls (Allied Radio Part No. 39K052).
Mounting hardware necessary to suit installation.

THE MOBILE RADIO CONTROL UNIT is installed under the radio in 20Q2918's "compact" car. The transceiver controlled by the unit is at the right, while an amateur-band converter occupies the space below the instrument panel. John Borzner is a technical writer in the Program Documentation Unit of General Electric's Defense Systems Department in Syracuse, New York. In addition to radio work, where he is active on the Citizen's Band, he has built in several refinements to his Lowrey spinet organ, including electronic reverberation.

John alsa has authored several articles for electronics magazines. One of his latest offerings was "Economical Highway FM" in the November, 1960 issue of Radio-Electronics.

FIG. 1. SCHEMATIC DIAGRAM of the transceiver control unit. A wide choice of components similar to those in Table I—Parts List, are available and may be substituted.



transformer. Any small transformer can be used here provided the DC resistance of the secondary winding does not exceed two ohms. Neon lamp NE-51 is connected in series with R_1, 180K, to serve as a pilot light. The supply is built on a small 4 x 6 x 1-inch aluminum chassis (Bud CB-1620).

TUNE-UP AND ADJUSTMENT —

The VHF portion of the receiver can be checked by feeding the audio output into the station receiver's phono input jack or into an audio amplifier (leave modules out). With 12 volts DC applied, the familiar superregenerative rush should be heard when the tubes warm up. If the detector does not superregenerate check RFC_2 and make sure the fine wire with which it is wound has not broken.

Frequency coverage can be checked with a grid-dip meter or signal generator. The low end of the band should hit between 48 and 49 megacycles with the detector components shown in the parts list. If the low end of the range is too high in frequency increase the value of fixed capacitor C_{18} across the detector *Inductuner* to 7 or 8 mmf. If desired, a small mica trimmer can be used for C_{18} to set the low frequency end of the range. The receiver should superregenerate to approximately 150 to 160 megacycles before giving up with a howl of protest.

To check the converter module plug it in and connect the converted output to a broadcast receiver. If only an AC-DC entertainment or a transistor type broadcast receiver is available it can be used by running an insulated lead from the converter output jack to the vicinity of the broadcast receiver loop antenna.

The tuning slug in the oscillator coil must be screwed in until approximately ¼-inch of the tuning screw protrudes above the oscillator can, otherwise this screw will not clear the cover of the cabinet. With the screw in this position the converter signal should be heard around 600 kilocycles on the broadcast band. Adjust the tuning screw on the oscillator can to hit a clear spot.

If converter output is desired higher in frequency in the broadcast band, capacitor C_{12} across the oscillator coil can be reduced in value as required.

Once the converter oscillator is tuned in on the broadcast receiver, tune in a signal on the VHF receiver and increase the setting of the volume control on the VHF receiver until its output modulates the oscillator. The average VHF signal will modulate the oscillator from 60 to 80 percent and the VHF receiver volume control can generally be turned full on and left there. Further volume adjustment can then be made with the broadcast receiver volume control.

If initial tests are made with the audio amplifier module plugged in for loudspeaker operation be sure to double check the polarity of the power leads. Reversed polarity will ruin the output transistors.

As with any other simple receiver, an efficient antenna system should be used for best results. For mobile operation a resonant quarter-wavewhip cut to the desired frequency and fed with RG-59/U is recommended. Unfortunately, no antenna system other than a special one such as a *Discone* will give uniformly good pick-up over the entire frequency range capable of being covered by the receiver. If good, all-frequency operation is desired for mobile operation the multi-resonant whip antenna shown in Fig. 10A will give good results in the most active portions of the spectrum. This antenna consists of three separate whips which can be made from discarded automobile antenna whips or aluminum rod. Secure the bottoms of the whips to a metal plate and use Lucite or other plastic spacers as shown in the diagram to maintain whip spacing of 3 inches. This antenna will give good pick-up on the 30- and 144-megacycle ham bands as well as on the 100-megacycle FM band and the 118-megacycle aircraft frequencies.

A similar antenna system for home station use is shown in Fig. 10B. This multi-resonant antenna is constructed from lengths of 300-ohm twin-lead which are secured to supports as high in the air as possible.

With either of the simple antenna systems shown the three-way VHF'er will give good reception of commercial FM stations 15 to 20 miles away[1]. Depending on their altitude, commercial aircraft can be copied out to 30 to 40 miles. Local 50 and 144-megacycle stations will also give good copy but don't expect to hear that 144-megacycle DX station your buddy down the street is copying with a 417A converter and 75A4 receiver!

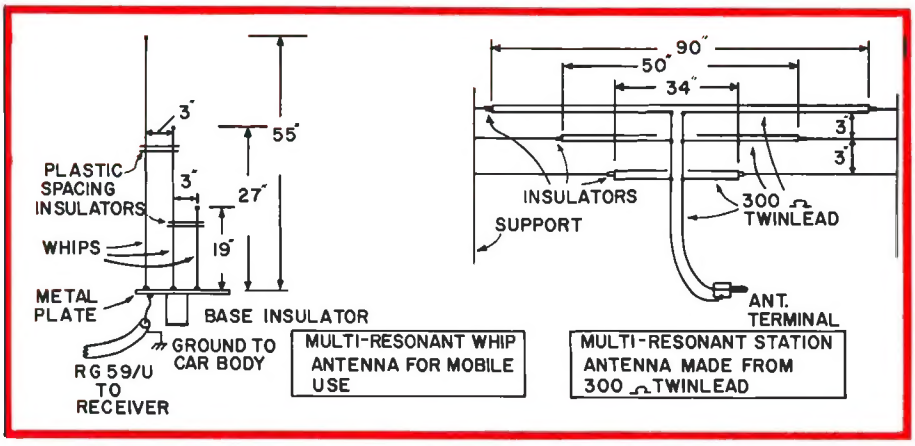


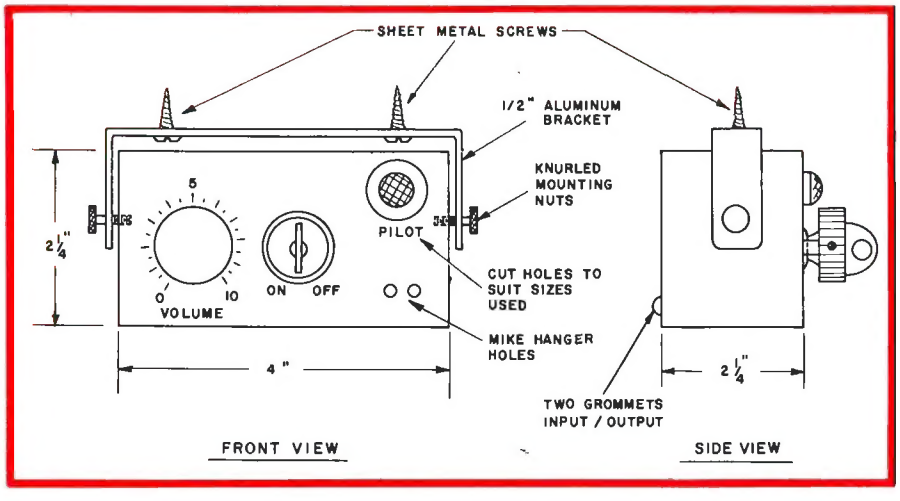
FIG. 9. CONSTRUCTION DETAILS of simple antennas which can be used with the VHF receiver to provide efficient pickup of signals over the 50 to 150-megacycle tuning range.

OTHER FREQUENCIES —

In anticipation of requests for operation of the receiver on frequencies other than 49 to 150 megacycles a number of tests were made with the *Inductuner* tuned circuits. The frequency coverage of the receiver can be lowered to 27 megacycles by adding fixed inductance in series with the *Inductuner*. However, when this is done the effective frequency coverage is drastically curtailed because the *Inductuner* becomes a small part of the effective tuned circuit and tuning range drops to less than five megacycles. Leaving the *Inductuner* "as is" and simply adding fixed capacity across each variable coil doesn't appeal to the superregenerative detector which refuses to "super" under these conditions.

If extended lower frequency coverage is desired the better approach would be to replace the Inductuner with a two-gang tuning capacitor and suitable coils for the desired frequency range. Have fun!

FIG. 2. MECHANICAL DETAILS of the control unit are shown in this view. Actual cabinet size will depend on components used, and the space available in the vehicle for the control unit.



[1]To copy FM stations the receiver should be tuned slightly to one side or the other of the carrier to permit slope detection. A high pitched audio squeal may be heard intermittently or continuously on some FM stations. This is caused by the superregenerative detector quench frequency beating against the supersonic tone signal transmitted by some stations for multi-plex operations such as store-casting.

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William G. Welsh, W1SAD

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He has devised comprehensive courses of instruction which include eight 1800-foot code practice tapes as well as voluminous text material. He has run off hundreds of copies of his tapes free of charge and sent them to voluntary study groups in nearly every state in the nation and at least twelve foreign countries. In addition, he prepared a 70-page instructor's handbook to help others teach radio.

The quality of his instruction is indicated by the 75-percent average of his students finishing the courses, an exceptionally high ratio. He has taught classes at many locations in the Boston area, and for two seasons conducted classes seven nights a week.

He obtained a notary public's commission to help his students process applications for FCC examination, and arranged with the FCC office for special examination sessions. His wife, Mrs. Marie Welsh, W1COL, often assisted, grading examination papers, and teaching classes when Mr. Welsh was away on business trips.

(Mr. Welsh is now WA6VTL.)

6th EDITION—SPECIAL DX LOG ISSUE

The double-size 16-page 6th Edition of the Special DX Log Issue, published in March-April, 1962 (Vol. 17, No. 2), is now available from more than 700 G-E Tube Distributors in the United States, as usual. It contains an updated listing of ARRL Official Countries for the DXCC Award, zone list for WAZ award, United States list for WAS Award, plus listings of Deleted and Banned Countries, Cross Index of Official Countries, and other handy information for the DX operator. Copies may also be ordered by mail directly from the G-E HAM NEWS office address on page 2 at the following prices:

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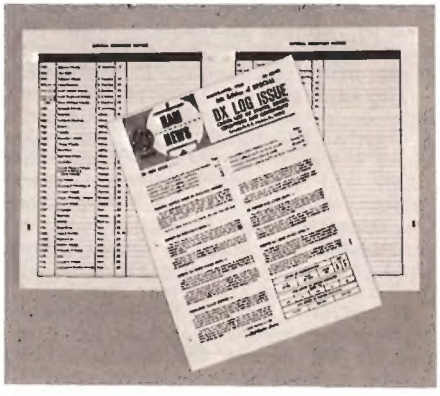

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